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FRAGMENTARY LEAVES

FROM THE

GEOLOGICAL RECORDS

OF THE

GREAT NORTHWEST,

—BY—

J. HOYES PANTON; M. A.

1884.

A paper read before the Society on the evening
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Fragmentary Leaves from the Geological Records OF THE GREAT NORTH WEST.

Notes of a Trip in the Far West—Description of the Prairie Steppes—The
Origin of Alkali—The Bow River Valley—Medicine Hat Coal Mines
—Discovery of Extinct Reptiles, Etc.

At Thursday's meeting of the Historical and Scientific Society, Mr. J. H. Pantou read his promised paper on "Places of Geological interest in the Northwest," as follows:—

To-night I purpose placing before you for consideration the result of some geological investigations, which I have made during the past summer at interesting localities in the Northwest. In August of this year, through the kindness of the Canadian Pacific Railway, I, in company with several members of this society, had the pleasure of visiting the regions as far west as the track was then laid.

Before entering upon a description of places, fraught with considerable geological interest, I shall direct your attention to some general observations upon the vast tract of country between Winnipeg and Calgary, after which I shall treat more particularly of the various outcrops visited, and from which the fossils I have presented to the society have been obtained. Leaving Winnipeg and pursuing our journey westward we soon cross the

FIRST PRAIRIE STEPPE.

or Red River Valley, which at Emerson is 52 miles wide and gradually increases as you proceed north. It is about 800 feet above the sea level and embraces an area of 6,900 square miles. Throughout this level region a rich black soil abounds underlaid in many places by layers of clay for a depth of 50 feet. Immediately below this apparently alluvial deposit is Silurian limestone, which is well exposed at several places along the Red River, Stony Mountain and the shores of Lake Winnipeg.

Beyond this region, distinguished for the almost inexhaustible fertility of its soil, we cross the

SECOND PRAIRIE STEPPE.

which has an elevation of 1,600 feet above sea level, 250 miles wide at its

southern limit and narrowing slightly towards the north it embraces an area of 10,500 square miles. This region differs in some respects from the former. The dark, rich soil is not so common, the surface is much more rolling, and the whole is underlaid by Cretaceous deposits. To some these physical characters, indicating a drier and warmer soil, have greater attractions than the level land of the Red River valley. Nothing of particular importance attracted our attention as we passed over this district, which, though containing much rolling land on the east side, passes into a level country westward.

THIRD PRAIRIE STEPPE.

In this great table land of the Northwest, extending from the western boundary of the last region to the Rocky Mountains, 465 miles wide on its southern boundary, with an elevation of 3,000 feet, there is an area of 134,000 square miles. As this possesses some features of more than ordinary interest, I shall direct your attention to it for a few moments. This district, while rolling in character, has also much prairie land. Here vast coal fields are found among the Cretaceous deposits, and in this region many of the lakes and ponds are strongly alkaline.

At the time of my visit this region indicated drought, but did not present that desert appearance I had anticipated from the reports of some who had described it. Although there are some parts comparatively sandy, yet there are vast areas of good soil, immeasurably better than many places which are now under cultivation in the eastern provinces. The soil seems sufficiently fertile, but the climate, owing to a limited rainfall, may be at fault. The problem which requires solution, in this part of the Northwest, is to what extent can the rainfall of a country be modified or increased by ordinary cultivation and the planting of trees?

The sooner data can be collected concerning this, and experiments undertaken to collect results bearing upon it, the sooner will much land become of value which now seems to offer no inducements to settlers, and at certain seasons present a very uninviting appearance.

At Moosejaw I observed fields in which the crops appeared in good condition, while the surrounding prairie presented a parched look.

There is no doubt but cultivation will tend to preserve moisture in the soil, by preventing the sun's rays acting directly upon the surface, and thus rapidly carry off the moisture by evaporation.

Many travelers over this part of the Northwest during the past summer have been struck with the growth of grain growing by the track, where it had likely fallen during the construction of the road. We observed it frequently, and were convinced that fertility was in the soil if favorable conditions surrounded the plant as it developed.

THE ORIGIN OF ALKALI IN PRAIRIE-PONDS.

The appearance of some of the alkali ponds in this district present a rather novel feature, especially those observed near Maple Creek. Here, as we approached in the evening, we saw the ponds lying to the north of the track presenting a most wierd-like appearance, surrounded by the rings of white "alkali," left as the waters evaporated. Bordering these were red rings, made up of a mass of "alkali" plants, largely of the species *Salicornia herbacea*. These peculiar plants exist and flourish in a soil impregnated with saline substances. In the struggle for existence they have survived where other forms of plant life have ceased to exist, and now hold a monopoly in the so-called "salty" districts. The presence of "alkali" in these comparatively dry areas is not a matter of surprise when we remember all soils contain a certain amount of soluble salts. In our Western districts these are carried into ponds which have no outlet. As evaporation goes on the waters become more and more saline, until they are so strongly impregnated that when the ponds dry up an alkaline incrustation is left. If the rain-fall was greater in these localities and the water carried off, as we find in other countries, the shallow ponds would no longer show incrustations from the accumulated salts held in solution. This alkali seems in most cases to be a mixture of calcium and magnesium sulphates, small quantities of calcium and magne-

sium carbonates and some soluble chlorides.

ORIGIN OF THE DEPRESSIONS AROUND THE LARGE BOULDERS ON THE PRAIRIE.

Another peculiarity observable in this district is, in many cases, the large stones occupy the centre of a considerable depression. So common is this feature that one is led to seek a reason for it. Some have attributed this to the work of buffaloes tossing up the dirt around the stone and frequenting such places until a considerable hole has been formed. I think that in addition to this wind and rain have done much to enlarge the depression.

One can readily understand that the wind sweeping over these immense treeless districts would drive away any loose earth around the stone. A small space is thus left for the accumulation of water running into the depression. This would wear down more soil which on drying would be again thrown out by the wind sweeping around the stone. Allow this to continue for a lengthened period and a large depression would be formed; in fact large enough to form the nucleus of a pond, which, on evaporating and the loose dirt from the bottom swept up the sides so as to form banks, would be increased in depth. Might not these agencies explain the formation of many of these ponds with no outlet and which in many cases show one or more large stones that may have been important factors in the first steps to their formation as they were ploughed round by buffaloes in amusement or swept by strong winds which encircled them? Having made a few remarks upon some of the most striking features observed as I crossed the country lying between here and Calgary, I shall ask your attention to some localities of more than ordinary paleontological interest. In placing the results of my labors before you I shall consider the places in the order in which they were visited and endeavor to carry your minds with me to these localities which to me have been spots of intense interest and much instruction.

CALGARY.

At Calgary I separated from our party; they pushed on to view the magnificent scenery of the Rockies, I to investigate some of the outcrops bordering the Bow River, near this place. We met not again till my work was largely finished and the trip at an end. On the morning after our arrival in this town of tents, with hammer in hand I started west-

ward to seek the rich fossil fields that lay beyond. At the confluence of the Elbow River with the Bow, there is an exposure of grey sandstone; but although of considerable thickness, it supplied no traces of primeval life, neither animal nor vegetable. Beyond this I walked over the beautiful oval-shaped valley in which it was at that time supposed the future site of Calgary lay. I was surprised at the fine mat of grass that covered this attractive valley, and on examination found that the soil overlying a bed of coarse gravel was not very deep. As I wandered over this apparently fertile locality, my mind was led to consider how this deposit had been formed. A closer examination of the gravel and alluvial soil upon it seemed to indicate that at one time the Bow River, which now skirts the valley, occupied a more central position, that the banks on either side were the result of it denuding power, and that at that time this coarse gravel was the bed of a river much larger than that which now remains. In the course of time the river current shifted to the side, the waters of the valley became more or less calm, and silty material was laid down until the whole valley became enriched with the deposit. The river seems then to have deepened its channel along the sides until all the water flowed through it and the former river bottom was left high and dry. On such an alluvial deposit rich herbage would naturally grow, and as years rolled on, the vegetation of the valley assume its present luxuriant condition. This conclusion seems to be borne out by the comparatively thin layer of rich dark soil and the bed of coarse gravel below it.

BOW RIVER EXPOSURE.

About five miles beyond Calgary an exposure of sandstone rock appears on the right bank of the Bow River and continues for some distance farther west, at least for two miles, the distance I examined. At this point I turned and began the work of investigation, knowing that long ere my steps were retraced for two miles, sufficient fossils would be obtained to test my carrying capacity. On every side the fragments of rock, which had been left as the "graders" completed their work, contained excellent impressions of fossil leaves of many varieties. The bank is about 200 feet high and largely made up of layers of grey sandstone, much of which is exceedingly fossiliferous. At this place I saw no other fossils but the remains of leaves. The

rock was of such a soft nature that complete forms were difficult to obtain, and it was only by taking a large fragment that a good specimen could be secured.

As the broken rock was used to protect the bank from the action of the swift current of the river there was no difficulty in finding excellent pieces for examination. I examined fragment after fragment, and endeavoured to chip off the superfluous stone so as to obtain a well defined leaf, but in vain, and I found that the only way to secure such was to submit to the work of carrying good sized specimens. But remembering that the escarpment farther east showed a harder rock I refrained making much of a collection from this locality and did not feel downcast when I saw many a beautiful leaf in this soft sandstone crack under the blows from my hammer. Here the lesson was thoroughly impressed upon me that although a rock may be rich in fossils it largely depends upon its nature whether well defined specimens can be secured.

Having come east to a place about five miles west of the supposed town site of Calgary the sandstone was found much harder, and did not break so irregularly as the rock already referred to. Here I secured some very fine specimens, and had my means of transport been better the society would have superior specimens to those in its possession. At this locality a high bank, probably 250 feet, overlooks the Bow River.

The track comes close to the water here, and considerable blasting of rock has been done to make way for it. The broken fragments lie along the river's edge as a protection to the bank, and thus become very convenient for examination.

Among this loose material I found innumerable remains of vegetable life, some stems, but chiefly leaves, very complete and readily identified if proper books of reference were accessible. From an examination of some works upon fossil leaves I am inclined to locate the specimens obtained among the genera, *Protophyllum*, *Corylus*, *Alnus*, *Platanus* and *Populus*, allied to some of our modern representatives such as the hazel, alder and poplar. Among the specimens secured at this exposure and donated to the society is a small but beautiful fern of a more or less feather-like appearance. In the higher layers of this escarpment many fossil shells were observed, em-

bracing several genera of univalves, and one bivalve, as the bivalves, of which there were many, belong to the genus *unio*, and bear a close resemblance to some of our modern clams. The univalves seem to belong to several genera. *Vivipara*, *Campeloma*, *Bulinus* and *Planorbis*. On breaking up some of the rock which contained the bivalve shells very complete casts dropped out. I might add here that the sandstone containing the shells seemed to be more compact and harder than that in which the leaves were found.

AN ENTOMBED BUFFALO.

At this place a condition was observed worthy of notice, as it explains how easily a person might be led astray by a too hasty explanation of certain facts.

The contractor at work on this division, (for at the time of my visit the track was not laid as far west as this) called my attention to the remains of a buffalo which his men found twenty-five feet below the surface, in a cutting through the river bank, while upon the surface stumps of huge trees were seen. Nothing seemed more natural than to suppose this buffalo had lain entombed for a long period of time, during which the deposits over it had accumulated and immense trees matured upon the soil which covered the imbedded remains.

Before venturing an answer to the question "How many thousands of years do you think this 'critter' has been buried?" after special attention had been called to the size of the trees which grew above it, I looked up the high banks and at once saw how the entombment might have taken place in recent times. A land-slide explained the mystery. Beneath this the buffalo had been buried, and as the trees carried down had been but little disturbed, they continued to flourish as if no change had occurred in their position. My questioner was pleased, and quaintly remarked to bystanders-by "that the buffalo aint so very old after all."

LARAMIE DEPOSITS.

The question which now presents itself is: To what period in geology do these deposits belong? Regarding this there seems to be a diversity of opinion, some locating them in the upper Cretaceous; others as lower Eocene; in other words, at the summit of the Secondary, or base of the Tertiary rocks. There is no doubt that there is a striking contrast between these fossils and what we find farther

east. In fact, among those found there is no resemblance to the Cretaceous which came under my examination.

From a comparison with fossils found elsewhere it would seem that these remains belong to what is known as the Laramie series of rocks, which are considered as a transitional group between the Cretaceous beneath and the Tertiary above.

These rocks were likely formed before the Rocky Mountains had made their appearance, as their arrangement and condition seem to indicate that the great changes which brought these mountains into existence, took place after their deposition.

BOW RIVER NEAR THE 12TH SIDING.

Having completed my observations at Calgary, the next place which engaged my attention was along the banks of the Bow River, about 100 miles west of Medicine Hat. I had been told by an enthusiastic passenger on the way up that in the banks of the river at this place, it was a common thing to find petrified fish. To obtain such was worthy any collector's effort.

For several hours I wandered along the river banks at this lonely spot, east of the Crowfoot Crossing, thoroughly examining the escarpment from the water's edge to the prairie level, 150 above the river. Not a trace of extinct life was discovered in the gravel and clay of the banks. Had I been fortunate enough to have left the train at the Blackfoot Crossing farther west, I certainly would have been better rewarded, for at that point a coal seam appears, near which there are no doubt objects of paleontological interest.

But here I had followed the instructions of one of the uninitiated in geology and learned, as I have on several occasions before, that such guides are not to be relied upon. They always see fossils in a magnified form and are never at a loss to identify them as belonging to existing types. They find fish in rocks which were formed long ere fish came into existence; backbones in formations deposited in seas which had passed away ages before vertebrates appeared; petrified wasps' nest in periods which had long preceded the creation of insects, and even mastodon teeth long anterior to the appearance of these gigantic forms upon the earth.

After a wearisome search, disheartened and greatly disappointed, I resought the track, which is not far from the river,

and took the first train east for Medicine Hat.

MEDICINE HAT.

In this locality I visited the coal exposure, which occurs on the north side of the river, about 8 miles above the town. As one passes over the prairie from the station, which is only about $1\frac{1}{2}$ miles from the mine, he sees no indication of the great ravine through which the Saskatchewan passes, and from which he is but a short distance. It is only when he has come right upon it that he beholds the work nature can perform through the agency of water. As you stand upon the bank of the Saskatchewan, 293 feet above the level of the stream, and see not only the channel worn out by this river, but also the immense lateral excavations made by streams no longer seen, and spring freshets of modern times, you are astounded at the impressive examples of denudation before you.

There being but little solid rock throughout this region, wherever water runs, only a short time elapses before immense cuttings through the clays appear. Saskatchewan coal mine is not located directly on the banks of the river, but on the sides of one of these great ravines. The following is a section of the cutting at the mine, the strata having a slight dip southeast:—

	Feet above the river.
Prairie level.....	293
Drift.....	
Sandy clays.....	250
Light sandy shales.....	210
Clay bands.....	190
Limestone band, 2 feet thick.....	
Dark clay shale.....	170
Light clay shale, 2 streaks of shells very fragmentary.....	160
Coal seam, 1 foot.....	150
Shale.....	
Coal, 8 inches.....	
Shale.....	
Coal, 10 inches.....	140
Clay shale.....	120
Iron band, 8 inches.....	
Coal, $\frac{1}{2}$ feet.....	110
Under-clay.....	
Sandy clay.....	100
Band of shells, 4 inches.....	90
Sandy clay.....	
Hard band, 6 inches.....	
Band of shells, 7 inches.....	
Coal, 8 inches.....	80
Iron band, 9 inches.....	
Coal being worked, $\frac{1}{2}$ feet.....	70
Under-clay, 3 feet.....	60
Coal, 2 feet.....	50
Sandy clay.....	40
Brown clay.....	30
Iron band.....	20
Light sandy clay.....	10
Water level.....	0

It is almost unnecessary to remark upon the coal from this place. Since my visit it has been brought to Winnipeg and over 1,500 tons of it have been burnt

with most satisfactory results. The mine is being worked so as to get out 300 tons per day, and yet the supply cannot keep up with the demand. It is easily kindled and burns with an intense heat and leaves no clinkers. Consumers consider that $1\frac{1}{2}$ tons is equivalent to 1 of anthracite. This enterprise furnishes a solution to the fuel problem of the Northwest where little or no wood is found, for we know that these coal beds having but little dip cover immense areas of our western country. A mine could scarcely be more favorably situated for access than this. The coal comes to the edge of the ravine, the seam has but a slight dip southeast, and thus can be worked readily. Mr. Lawson, the able manager at the mine who kindly gave me much information about this locality, told me that he had been able to do as much work in two weeks in getting the mine under way as had taken him two years with coal mines in the Eastern Provinces.

The coal can either be rolled down to the river's edge to be transported by boat, or drawn up an incline to the prairie level and shipped by train to points east and west.

Upon the opposite side of the river the remains of petrified trees are very common, some of these belong to types entirely different from those which now flourish on the banks of the Saskatchewan and seem to indicate that primeval forests of Coniferous trees existed here in a different climate from the present. Many of the shells found in the band some 200 feet below the prairie level are representatives of the oyster family. A few of a very fragile nature belong to a genus which I have not as yet been able to identify. The presence of oyster shells 200 feet below the prairie level in a region now removed 2,000 miles from the sea is very suggestive of the wonderful changes which this great country has undergone in ages long receded into the past. In collecting specimens from these clay beds I gained new experience. At Selkirk quarries, Stony Mountain and many outcrops I have visited in the east, I had invariably found the remains so thoroughly petrified that little or no care required to be taken in carrying them, for they were really stones.

But here the shells were of an entirely different nature. They approached nearer their original condition except that they were exceedingly fragile and required to be handled with the greatest care. In some

cases as soon as they were exposed to the air they crumbled away.

To secure such it is necessary to be furnished with a number of small boxes into which they can be carefully packed.

110 feet above the river a red band of clay appears, which likely owes its color to the action of fire in the seam of coal below. Farther down the river this clay has a richer color, almost approaching vermillions. As neither lime nor magnesia is present, and as it possesses a fine compact texture we may reasonably expect that ere long the banks of the Saskatchewan will supply clay for the manufacture of a superior kind of pottery.

The deposits of this locality seem to indicate that they are of Cretaceous age.

IRVINE RAVINE.

Twenty miles east of Medicine Hat we reach Irvine station. Lying south of this about one mile is a locality of more than ordinary scientific interest, and which for convenience I shall call Irvine Ravine. Here in the spring of this year Mr. Lawson, of Medicine Hat Coal Mine, while prospecting for coal discovered the remains of what appeared to be an animal of reptilian nature. On his return to Winnipeg a reporter interviewed him, and, as most of you remember, a short notice describing this fossil appeared in the daily papers at that time.

In July Principal Dawson, of McGill College, while visiting the Northwest heard of this discovery and set out to obtain the remains, but was unable to find them. When I visited the Saskatchewan coal mine in August I saw Mr. Lawson, told him of Dr. Dawson's failure and desired him to give me another sketch of where it lay, at the same time showing him the outline Dr. Dawson had kindly given me to make corrections if necessary.

Furnished with a sketch somewhat different from the one I had, I set out with considerable enthusiasm to seek this fossil of higher type than I had as yet discovered. It was a bleak day on which my companion (a stranger whom I had met at Medicine Hat, and who when he heard the errand upon which I was going desired to take part in the search) and I left Irvine station to wend our way across the flats to the ravine.

A FORLORN HOPE.

We followed the directions, and gradually ascended the hill on the trail which leads to the Cypress Hills. As soon as we reached the summit and beheld the complicated nature of the coulee, an im-

mease central ravine and innumerable lateral ones, we were convinced that we were undertaking a forlorn hope. The sketch was consulted, but all was obscure in this wild spot. Among the rugged ravines we climbed hour after hour, seeking in vain the reptile that had lain so long among these lonely hills. Though apparently unsuccessful seeking the reptilian remains, still we saw much that was exceedingly interesting and instructive.

WORN ROCKS.

The effect of "weathering" upon the rocks of this place is astonishing. So striking is the result that my companion observed frequently, "It looks as if some of these hills had been pounded to pieces." Among the debris we observed numerous crystals of selenite, which appear to have been in the upper layers of clay. We also found many fragments of large shells, not unlike the genus *Mactra*, but no complete specimens were seen in those denuded hill tops. The weather had destroyed all. Some that appeared comparatively whole broke to pieces on handling. But at one place, where the weather had effected less change, we found one very complete shell, well replaced by silica.

On several of these "weathered" hills the selenite lay about almost like gravel, much of it in perfect single crystals three inches long and in beautiful masses of compound forms.

In several parts of the ravine layers of ironstone were observable, intercalated among strata of gray sandstone, and exposures of coal in several places, but the seams were comparatively thin. When the hope of finding reptilian remains was beginning to fade, and my companion becoming disheartened, for he had come expressly to see the interesting relics of past life, our energies were revived by finding four thoroughly petrified fragments of bone. These lay on the side of the hill, and appeared as if they had fallen from the layers higher up. Our fallen hopes much revived by this discovery, with renewed vigor we climbed the hill-side, where we expected to find more remains in their original position.

EXTINCT REPTILES.

Though this seemed from our sketch to not be far from from what we sought, still we were forced to abandon further search for the reptile, cross over to another part of the ravine and confine our attention to the lofty sides of the escarpment there.

Here a magnificent exposure appeared largely made up of beautiful sandstone, comparatively soft, interspersed with bands of stone more or less ferruginous and in some places seams of inferior coal.

The effect of the weather upon this soft sandstone was very marked, much of it appeared to have crumbled away leaving shelves of the ironstone, along which we could walk. In some cases the crumbling sand had fallen down the sides and covered over cave-like spaces, into which we sometimes fell as we walked along the sides of the ravine, the sandy covering which appeared to bridge over these holes proving too thin to sustain our weight.

Along the face of this escarpment and usually near the layers of coal we saw several bones protruding from the rock, but as often as we attempted to dig them out all crumbled away except the portion we saw and which seemed to have hardened by weathering.

On some of the elevated shelves we found excellent fragments which the weather through long periods had prepared for us. As we found these fragmentary remains in eight different places considerably removed from each other we concluded that we had recovered parts of eight different animals. A small pick would have done good service in this soft sandstone.

My companion no longer doubted that the remains of extinct animals could be found in Irvine ravine and felt amply repaid for all his exertions in this wild, rough and lonely spot. We did not have the good fortune to find any teeth or skull bones, and though we found fragments of immense thigh bones, a hip joint and some huge vertebrae, still we secured nothing by which we could identify the species to which these cretaceous dinosaurs belong.

Had I been able to have carried the bones I might have brought many more with me, consequently I took those only which were the most typical, such as the peculiar vertebrae of this extinct order and other parts, showing that these animals were of gigantic size.

AN INTERESTING LAND-MARK.

The bones of one of the largest forms observed lay at the foot of the escarpment near the entrance of the ravine a short distance to the right of the trail leading to the Cypress Hills, and not far from a surveyor's mound, marked section 30,

township 11, range 3, west of fourth meridian.

Taking this mound as a starting point, I am quite sure prolific results will reward future explorers who investigate the main ravine and some of the principal lateral ones. At places in the coulees we came upon large quantities of petrified wood, which had fallen from the rocks above. It lay in a confused heap, and bore a marked resemblance to a pile of ordinary stove wood, but closer inspection showed that it was the silicified remains of extinct trees, portions of which could be seen in the sandstone. As the strata at one of these places seemed well defined, I took a sketch of the escarpment, a vertical section of which may be represented as follows, but it must be remembered that this is not a uniform arrangement in the ravine, for the strata varied very much in different parts:—

Prairie level.....	1 foot
Dark soil.....	3 feet
Dark clays.....	3 "
Brown layer.....	1 "
Light clay.....	40 "
Dark sandstone.....	6 "
Light " with petrified wood.....	8 "
Dark clay.....	25 "
Greenish clay, with some selenite ...	20 "
Light-colored sandstone.....	

I have directed your attention to this place, which I have endeavored to describe carefully, so that our society may follow up research in a locality where there will likely be found some well preserved forms of extinct reptilian life, and probably some birds allied to those wonderful forms which have been discovered in the cretaceous deposits of the United States.

There is still to be found the remains which Mr. Lawson saw. I was told by a member of the Mounted Police that there is, about fifteen miles up the ravine, the remains of a huge lizard-like creature in the rocks: that it has been known to the Indians for a long time, and by them held in superstitious awe under the name of the "great lizard."

There are sufficient attractions for a visit to this place, and who would venture to foretell the future discoveries that may be made in the sandstone strata of these lofty weather-worn hills, by enthusiastic followers in the line of original work.

BUFFALO LAKE.

This is an enlargement of the Qu'Appelle River which runs like all the rivers of the 2nd prairie level through valleys from 150 to 200 feet below the surface of the prairie. It is about fifteen miles north of Moose Jaw, some thirty-two

miles long and from half a mile to a mile wide. At the place first examined the banks were chiefly sand with a pebbly beach. We proceeded about half a mile westward. Here the whole shore was strewn with broken rock and fossil remains. These were the debris of an escarpment some thirty feet high, sloping back from the lake, covered with a dense growth of shrub and underbrush.

From the cliff, fragments of the coarse grained sandstone of considerable size were found mixed with the sandy drift which lay on top of the cliff. The remains were evidently of the Cretaceous Age. The cliff had at one time been an oyster bed, and numerous specimens of the genus *Inoceramus* were found. No fossil wood was observed, and although the fossils were comparatively numerous the species were limited to few forms. A thorough examination of this exposure would likely be well rewarded by the discovery of some interesting fossils.

PENSE STATION.

Here I had the pleasure of examining some boulders of great interest. At this place the drift is very thick. A well has been bored 400 feet and solid rock not yet reached. About three miles from Pense Station on Section 30, Township 16, Range 22, west of the second meridian, a well was dug this summer on the farm of J. H. Poyser, Esq., which has attracted considerable interest. When about 35 feet below the surface, a large oval-shaped stone of a somewhat gray color was encountered. There were no external indications of its being fossiliferous. To large to handle, a sledge was given to the digger who found to his surprise that with but a comparatively slight blow it broke into many pieces, and revealed an innumerable quantity of most beautiful shells. At the time of my visit many had been carried away, but I secured some six varieties, consisting of one exceedingly beautiful *Ammonite* about three inches in diameter, bearing two rows of tubercles with distinctly marked sutures of the septa, and the shell in a highly nacreous condition. One *Baculite* two inches in length, one rare univalve with highly sculptured shell, and three varieties of bivalves, most of which belong to the genus *Ostrea*. The stone, large portions of which I examined, seemed to contain cavities not unlike what are observed in older rocks bearing quartz crystals, seams filled with a yellowish mineral substance also appeared, and these, no doubt,

rendered the boulder so easily broken. The matrix which contained the fossils when compared with the cretaceous limestone of the Rocky Mountains, appeared to be much the same in physical characters and chemical composition.

This boulder removed far from its parent rock, had likely been transported during the Glacial period when an immense river of ice carried fragments of rock eastward and left them upon our prairies hundreds of miles from where they were *in situ*.

These fossils are remarkable, not only for their numbers, but also for the beautiful condition in which they are found, more nearly resembling the pearly shells of modern seas than the remains of mollusks extinct for ages. Some of these formed a portion of the society's exhibit at St. John and Boston, where they were greatly admired.

This isolated fossiliferous boulder indicates that there is a rich fossil field somewhere along the eastern border or summit of the mountains west, where shells, characterized by great beauty, are likely to be discovered.

About six feet above this stone another boulder not quite so large was found. This was much harder than the former, of a reddish color and somewhat of a granitic nature. One surface was well polished and distinctly marked with glacial striae.

This closes a description of the various outcrops visited during my trip to Calgary, and from what has been placed before you for consideration, one may readily infer that our Northwest Territories offer great inducements for geological investigation, and will for many years afford great attractions to the members of this society who are inclined to work in the department of science.

The results of my visit to the places referred to in this paper may be summarized as follows:—

SEVEN MILES WEST OF CALGARY—LARAMIE DEPOSITS.

Impressions of leaves belonging to the genera *Protophyllum*, *Corylus*, *Alnus*, *Platanus*, *Populus*.

Univalve shells of the genera *Campeoloma*, *Bulinus*, *Planorbis*, *Vivipara*.

Bivalve shells of the genus *Unio*.

MEDICINE HAT—CRETACEOUS DEPOSITS.

Petrified wood and coal.

Bivalve shells 200 feet below the prairie level, largely of the genus *Ostrea* and an undetermined species.

IRVINE RAVINE—CRETACEOUS DEPOSITS.

Petrified wood in large quantities

Fragmentary remains of eight extinct
Vertebrates, some of which are of the
order Dinosauria.

Innumerable crystals of selenite.

Shell fragments of the genus *Ostrea*,
and a very complete specimen of *Mactra*.

BUFFALO LAKE—CRETACEOUS DEPOSITS.

Genera *Mactra* and *Inoceramus*.

A mass of shell fragments not identified.
Some small cretaceous Bivalves.

PENSE SPATION—CRETACEOUS DEPOSITS.

Many fossils of the genera *Inoceramus*
and *Ostrea*.

A rare specimen of the *Ammonite*, one
Baculite.

Many small shells of an undetermined
species.

A beautifully sculptured Univalve.

